ADDITIONS TO THE BIONOMICS OF SINEA DIADEMA (FABR.). (*Reduviidae, Hemiptera.*)

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A brown, spiny-legged bug somewhat more than a half inch long, *Sinea diadema* is by far the most common member of its family in Illinois. This article releases new data obtained by us mostly at Urbana to supplement the valuable foundation studies on this species contributed by Readio (1924, 1927).

Wintering Stage.

In the Urbana area, this predator passes the winter exclusively in the egg stage. We present several kinds of evidences in support of this conclusion. First, while a few females taken in September had not yet begun oogenesis, most individuals of this sex obtained in that month and in October either contained mature brown eggs and immature white oocytes or had expended their adipose stores and turned to a dark soupy consistency indicating senility. Concurrently the number of adult bugs decreased sharply as October progressed, only one living adult having been secured by sweeping in November of 1940 and 1941. Significant also is the fact that our departmental insect collection contains many adult specimens bearing dates of September and October but only one taken in November.

Second, neither does the collection have adults captured in April and May, nor did we obtain such by weekly sweepings during March, April and May, 1942, or by less systematic efforts in 1941. Instead, nymphs in the first instar appeared in the net on April 17 and 24, individuals in the second instar were taken on May 2 and 8, and others in successively more advanced stadia from May 16 to June 20. Beginning in mid-June, the nymphs matured and transformed to the adult form.

Third, we demonstrated experimentally that the egg can survive central Illinois winters. Eggs laid from September 28 to November 2, 1939, by females recently from the field, were placed out of doors between October 24 and November 2 and left exposed until March 2, 1940. Returned to the laboratory on the latter date, 33 percent of 131 eggs yielded nymphs in from six to 15 days, and dissections of 81 sample eggs removed from 17 masses showed that all clusters but one, which had perhaps not been fertilized, contained embryos. These had advanced to somewhat different states of development, those in the earlier states being brighter brown and more flexible, and contained larger amounts of heavy whitish homogeneous granular yolk than others. On the other hand, embryos that

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had proceeded almost to the hatching stage when set out of doors in the fall were dead on examination in March. These results indicate that perhaps only the embryos in the earlier developmental phase can survive winter temperatures. Records furnished by Henry P. Etler, observer in the local federal weather station, showed the egg masses had undergone 11 days of subzero temperature, including lows of −11, −12 and −13° Fahr. in January, or a mean of 7.1+° Fahr. for the month.

These facts show then that the reproducing adults present from September to early November die before the advent of winter, leaving the egg alone to carry its species through the cold season. No search was made for eggs in the field.

Life Cycles.

Two generations are passed in a year at Urbana. The first begins with nymphs hatched from the overwintered eggs The occurrence of nymphs in the first instar on April 17 and 24, 1942 indicates hatching took place about the middle of that month. The further nymphal development at Urbana is indicated by records for 1942: second instar, May 2 and 8; third, May 16 to 30 (June 4, Park Ridge, Ill.); fourth, May 28 (June 18, Oak Harbor, O. and June 27, Sebring, O.); fifth, June 14 to 20 (June 18, Oak Harbor). Supplementing these weekly samples are data from other years and sources, as follows: many advanced nymphs occurred between June 15 and 30, 1938; individuals in the second instar were taken on May 30, 1940, and numerous others representing the third to fifth stadia came into the net from June 6 to 25, 1940; and many of successively more advanced instars developed from May 17 to June 24, 1941. The adult state, which climaxes this cycle, had been attained as indicated by the following dates: June 19 to August 8, 1940; June 7 to July 19, 1941, and June 15 (a pale, soft female) to July 4, 1942. Thus, the first generation develops from mid-April to about mid-June, and the adults persist into August at Urbana.

The adults of the first generation as a whole therefore seem to live as long as six weeks and initiate the second cycle of the year from late June to early August. Nymphs in various but mostly the more advanced instars were taken on September 7, 1938, August 8 to September 28, 1940, and July 26 to August 30, 1941. All nymphs had transformed to adults on September 23, 1938, September 21, 1940, and September 16, 1941. Females dissected on September 6 and 23, 1938, were still in the pregravid state, but the lots examined from October 11 to 21 contained mature eggs and oocytes, as did also samples taken on September 21, 1939, September 23 to October 28, 1940, and September 19 to October 25, 1941. Occurrence of the adult in September–October is reflected also by the relatively large

numbers of specimens bearing those dates in student collections. However, the adult population declined numerically during October, with the result that only one individual was found on November 2, 1940, and none on November 3, 1941, in situations well populated in the previous month. The activities of the second generation therefore end with oviposition in September–October, leaving the eggs to start the first new generation in spring of the ensuing year.

To summarize, the three stages of the two cycles respectively appear approximately as follows: egg, September to April and July to August; nymph, April to June and July to September; adult, June to August and September to early November.

Diet and Development.

Two series, each consisting of 20 nymphs obtained in the wintering experiment described above, were carried through to determine in a preliminary way the relation of quantity of diet to growth. Although both the diets chosen proved to be inadequate to sustain the nymphs to adulthood, the results are worthy of a brief statement. Ninety-four percent of series I died in the first instar on a diet of one adult *Drosophila melanogaster* in five days, and the survivors starved in the second instar on an allowance of one *Drosophila* in three days.

The nymphs of series II, fed at the rate of one, two, four, eight and 16 *Drosophila* flies per day in the five instars, respectively, died as follows: 70 percent in the first instar; 0.0 in the second; 5.0 in the third; 20.0 in the fourth, and 5.0 percent in the fifth stadium. In the course of their varied lifetimes, the 20 nymphs sucked out a total of 364 flies, or an average of 18.2 flies per bug.

Process of Preying and Feeding.

The preying stance and manner of seizing prey have been noticed by Parker (1916), and structural adaptions for predatism were described by Barber (1923). These accounts are supplemented here by two observations made by the senior writer in the field. One of these concerns a male that captured and sucked out a female adult of the tarnished plant bug, *Lygus oblineatus* (Say) on June 25, 1940, on an umbel of tansy, and the other involved a female seen on October 5, 1940 holding a newly-seized and still vigorously-struggling adult female of *Chauliognathus pennsylvanicus* (De G.) on an *Aster*.

When *Lygus* came within range of vision,—a distance of four inches, the male *Sinea* oriented himself to face the mirid and quickly assumed his waiting stance. In this posture, the grasping front legs are raised aloft sharply, with the femora almost vertical and the tibiae forward and subhorizontal, and the body elevated in front, lowered behind. When *Lygus*

remained but a quarter inch away, the predator lunged forward and downward, but failed to make the catch. Resuming the alert stance at once, he waited until *Lygus* approached almost within reach of the fore legs, hence only a short dash was needed to secure the prey. Both front legs embraced the small captive, the stout spiny femora bearing down from above while the slender tibiae clamped upon it from below. The grip of the legs and the prompt penetration of the body by the stylets inactivated the victim at once. *Sinea* crawled about for several brief periods during the 26 minutes that elapsed between capture and relinquishing the empty skeleton of the prey. In the course of feeding, he radically changed the position of his captive 15 times, introducing the stylets at as many, and more, different points of the body, including head, pronotum, lateral and ventral surfaces of the thorax, the apex of a femur and all aspects of the abdomen,—the flexible beak being introduced beneath the wings from the side when the dorsum was pierced.

When quietly engaged in feeding, *Sinea* relaxed his leg hold on the prey in part or entirely, permitting it to dangle from the end of the stylets or rest lightly on the flower, but in shifting the mirid from one position to another, he seized it anew between femora and tibiae of both grasping legs. When crawling from place to place, he either gripped the prey with his legs or dragged it along, holding it by the recurved end of the stylets.

By contrast, the comparatively strong, large *Chauliognathus* resisted decreasingly with kicking legs, vibrating antennae and chewing movements of the mandibles for five minutes after capture. During the 5.3 hours that followed inactivation, the female *Sinea* continually held her prey with her fore legs and beak, and turned it at intervals, inserting the stylets principally at the relatively soft conjunctivae of the body regions and the abdominal segments. It is not possible to state whether or not the bug fed continuously during the hours she held the beetle.

Postmortem examination of the prey insects showed all fluids and liquefiable solids had been drawn out of *Lygus*, but the abdomen remained normally extended,—the strong ovipositor probably preventing contraction. However, the abdomen of *Chauliognathus* had telescoped forward visibly. The relinquished beetle weighed 0.0218 gram, as compared with 0.0430 gr. which represents the average of four normal, newly-etherized adults of the same species. Assuming that the beetle victimized by *Sinea* was average in weight, this predator sucked out approximately 0.0212 gr. of substance, or about half of the original body weight of the prey.

When seen preying in the field, *diadema* almost always stood on the top of plants,—usually on flowers, with the inert prey dangling from the stylets beyond the end of the labium. Flowers of all sizes and colors are utilized for hunting, the choice of plant probably being determined by the attractiveness of the flower to potential prey rather than by its color or form. Plants found inhabited included *Aster multiflorus*, *Achillea millefolium*, *Rudbeckia*, *Bidens* and *Solidago*.

Insect Prey of Diadema.

The prey data listed in table I below were garnered from published articles cited in the Review of Applied Entomology and the Bibliography of Economic Entomology. The 40 separate records given in table II were secured through the direct observations of the present writers under field conditions at Urbana, Illinois. We are pleased to acknowledge the help of specialists at the United States National Museum in the identification of predatory and prey species concerned here.

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TABLE I. RECORDS FROM LITERATURE.

PREY SPECIES	ORDER	FAMILY	STAGE	SOURCES
Anthonomus grandis Boh.	Coleoptera	Curculionidae	Adult	Morgan (1907)
Diabrotica vittata (Fabr.)	Coleoptera	Chrysomelidae	Adult	Chittenden (1919)
Leptinotarsa decemlineata (Say)	Coleoptera	Chrysomelidae	Adult	Chittenden (1907)
Lema nigrovittata Guer.	Coleoptera	Chrysomelidae	Larva	Blaisdell (1893)
"Cankerworms"	Lepidoptera	Geometridae	Larva	Lugger (1900)
"Cotton caterpillars"	Lepidoptera	———	Larva	Lugger (1900)
"Small caterpillars"	Lepidoptera	———	Larva	Ashmead (1895)
Laphygma frugiperda S. and A.	Lephidoptera	Noctuidae	Larva	Luginbill (1928)
Prodenia praefica Gr.	Lepidoptera	Noctuidae	Larva	Blanchard and Conger (1932)
Fenusa pumila Klug	Hymenoptera	Tenthredinidae	Adult	Friend (1933)
Caliroa cerasi L.	Hymenoptera	Tenthredinidae	Larva	Webster (1912)
"*Vespa diabolica*"	Hymenoptera	Vespidae	Adult	Asron (1929)
"Gall fly"	Hymenoptera	Cynipidae	Adult	Walsh (1863)
"Cotton aphides"	Homoptera	Aphididae	———	Ashmead (1895)

Bethune (1899) described an instance in which an Ontario boy was said to have suffered a "fatal bite" from *Sinea diadema*.

TABLE II. ORIGINAL RECORDS.

PREY SPECIES	ORDER	FAMILY	STAGE OF PREY	DATE OF RECORD	STAGE AND SEX OF PREYING *Sinea*
Chauliognathus pennsylvanicus (Deg.)	Coleoptera	Cantharidae	Adult	Sept. 16, 1938	Adult male
			Adult	Oct. 5, 1940	Adult female
Diabrotica 12-punctata (Fab.)	Coleoptera	Chrysomelidae	Adult	Oct. 5, 1940	Adult female
			Adult	Sept. 29, 1939	Adult male
			Adult	Sept. 29, 1939	Adult female
			Adult	Oct. 16, 1939	Female of coupled pair

			Adult	Sept. 21, 1940	Adult male
			Adult	Oct. 5, 1940	Female of mating pair
Diabrotica longicornis (Say)	Coleoptera	Chrysomelidae	Adult	Sept. 28, 1940	Adult male
——— ———	Lepidoptera	Geometridae	Larva, one inch long	1938	Adult male
Feltia ducens Wlk.	Lepidoptera	Noctuidae	Adult	Sept. 28, 1940	Adult male
——— ———	Lepidoptera	———	Small larva	Sept. 16, 1939	Adult male
Halictus pilosus Sm.	Hymenoptera	Halictidae	Adult	Sept. 19, 1939	Adult male
Halictus near *pilosus* Sm.			Adult	Sept. 13, 1939	Adult male
			Adult	Sept. 29, 1939	Adult male
Halictus sp.			Adult	Oct. 17, 1938	Adult male
			Adult	Sept. 29, 1939	Adult male
Undetermined bee	Hymenoptera	———	Adult	Sept. 29, 1939	Adult female
Odynerus anormis Say	Hymenoptera	Vespidae	Adult	Oct. 14, 1939	Adult male
Oxybelum emarginatum (Say)	Hymenoptera	Sphecidae	Adult	June 25, 1940	Adult male
Sphaerophoria cylindrica (Say)	Diptera	Syrphidae	Adult	June 25, 1940	Adult female
Toxomerus geminata (Say)	Diptera	Syrphidae	Adult	June 25, 1940	Female of coupled pair
Eristalis sp.	Diptera	Syrphidae	Adult	Oct. 16, 1939	Adult male and adult female of *Phymata pennsylvanica*

TABLE II. ORIGINAL RECORDS (Continued)

PREY SPECIES	ORDER	FAMILY	STAGE OF PREY	DATE OF RECORD	STAGE AND SEX OF PREYING *Sinea*
Hylemya cilicrura (Rond.)	Diptera	Anthomyidae	Adult	June 13, 1941	Nymph
? Hippelates spp.	Diptera	Titaniidae	Adult	June 28, 1941	Adult male
Eugnoriste occidentalis Coq.	Diptera	Fungivoridae	Adult	June 25, 1940	Third instar nymph
Harmostes reflexulus (Say)	Hemiptera	Corizidae	Adult	June 12, 1941	Adult female
Lygus oblineatus (Say)	Hemiptera	Miridae	Adult	Sept. 5, 1938	Adult female
			Adult	Sept. 6, 1938	Adult female
			Adult	Sept. 8, 1938	Adult
			Adult	Sept. 30, 1938	Adult female
			Adult	Oct. 9, 1938	Adult female
			Adult	Oct. 10, 1938	Adult female
			Adult	Oct. 11, 1938	Adult
			Adult	Sept. 5, 1939	Adult male
			Adult	Sept. 7, 1940	Fifth instar nymph
			Adult	Sept. 26, 1940	Adult male
			Adult	Oct. 21, 1940	Adult female
Adelphocoris rapidus (Say)	Hemiptera	Miridae	Adult	Sept. 23, 1939	Adult
			Adult	Sept. 25, 1939	Female of mating pair